MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of Higher Education
Far Eastern Federal University
(FEFU)
INSTITUTE OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)

FUND OF EVALUATION TOOLS
for the discipline (module) "Human Genetics"

Vladivostok
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List of Forms of Assessment Used at Various Stages of Competence Formation in the Course of Mastering the Discipline of the Module

Item No.	Supervised sections/topics of the discipline	Code and name of the indicator of achievement	Learning Outcomes	Evaluation Tools	
				Current control	Intermediate Attestation
1	Section 1. Molecular and cellular levels of organization of biological systems.	PC-1.6 Uses knowledge in medical genetics, immunology, epidemiology and therapeutics to conduct research to assess the efficacy and safety of medicines	Knows the theoretical foundations of research in the field of assessing the efficacy and safety of medicines He is able to use his knowledge in the field of medical genetics, immunology, epidemiology and therapy to conduct research in the field of assessing the efficacy and safety of drugs Proficient in research methods in the field of assessing the efficacy and safety of medicines	Interview	Questions for the test

2	Section 2. Genetic information in the process of regulation of homeostasis and reproductive function of the body.	PC-1.6 Uses knowledge in medical genetics, immunology, epidemiology and therapeutics to conduct research to assess the efficacy and safety of medicines	Knows the theoretical foundations of research in the field of assessing the efficacy and safety of medicines He is able to use his knowledge in the field of medical genetics, immunology, epidemiology and therapy to conduct research in the field of assessing the efficacy and safety of drugs Proficient in research methods in the field of assessing the efficacy and safety of medicines	Colloquium	
3	Section 3. Ontogeny as a Process of Realization of Hereditary Information.	PC-1.6 Uses knowledge in medical genetics, immunology, epidemiology and therapeutics to conduct research to assess the efficacy and safety of medicines	Knows the theoretical foundations of research in the field of assessing the efficacy and safety of medicines He is able to use his knowledge in the field of medical genetics, immunology, epidemiology and therapy to conduct research in the field of assessing the efficacy and safety of drugs Proficient in research methods in the field of assessing the efficacy and safety of medicines	Test	
4	Section 4. Basic concepts of modern genetics. The role of heredity and environment in the formation of the phenotype.	PC-1.6 Uses knowledge in medical genetics, immunology, epidemiology and therapeutics to conduct research to assess the efficacy and safety of medicines	Knows the theoretical foundations of research in the field of assessing the efficacy and safety of medicines He is able to use his knowledge in the field of medical genetics, immunology, epidemiology and therapy to conduct research in the field of assessing the efficacy and safety of drugs Proficient in research methods in the field of assessing the efficacy and safety of medicines	Interview Test	

5	Section 5. Molecular Genetic Concepts of Biogenesis and Evolution.	PC-1.6 Uses knowledge in medical genetics, immunology, epidemiology and therapeutics to conduct research to assess the efficacy and safety of medicines	Knows the theoretical foundations of research in the field of assessing the efficacy and safety of medicines He is able to use his knowledge in the field of medical genetics, immunology, epidemiology and therapy to conduct research in the field of assessing the efficacy and safety of drugs Proficient in research methods in the field of assessing the efficacy and safety of medicines	Test Abstract	

Scale for Assessing the Level of Achievement of Learning Outcomes for the Current and Intermediate Certification "Human Genetics"

Points (rating score)	Levels of achievement Training		*Requirements for the formed competencies*
	Current & Intermediate certification	*Intermediate Attestation*	
100 – 86	*Increased*	"Passed" / "Excellent"	Freely and confidently finds reliable sources of information, operates with the information provided, has excellent skills in analyzing and synthesizing information, knows all the basic methods of solving problems provided for in the curriculum, knows typical mistakes and possible difficulties in solving a particular problem and is able to choose and effectively apply an adequate method for solving a particular problem. trouble
85 – 76	*Base*	"Passed" / "Good"	In most cases, he is able to identify reliable sources of information, process, analyze and synthesize the proposed information, choose a method for solving a problem and solve it. Makes single serious mistakes in problem solving, experiences difficulties in rare or difficult cases of problem solving, does not know typical mistakes and possible difficulties in solving this or that trouble

75 – 61	*Threshold*	"Passed" / "Satisfied"	Makes mistakes in determining the reliability of information sources, is able to correctly solve only typical, most common problems in a particular area (process information, choose a method of solving a problem and solve it)
60 – 0	*Level Not Reached*	"Failed" / "Unsatisfactorily"	Does not know a significant part of the program material, makes significant mistakes, performs practical work unconfidently, with great difficulty.

Current attestation in the discipline (module) "Human Genetics"

Current certification of students in the discipline *"Human Genetics"* is carried out in accordance with local regulations of FEFU and is mandatory.

Current attestation in the discipline is carried out in the form of control measures (*colloquium, interview, essay)* to assess the actual results of students' learning and is carried out by the leading teacher.

For each object, a description of the assessment procedures is given in relation to the assessment tools used.

Assessment Tools for Ongoing Monitoring

Questions for Colloquia

1. Morphology of euchromatin and heterochromatin regions of chromosomes.
2. Structure of chromosomes in mitosis.
3. Genomic mutations (polyploidy) and their phenotypic and genotypic effects.
4. Chromosome structure in meiosis.
5. Cytological mechanism of crossing-over.
6. Characteristics of prophase 1 of meiosis.
7. Meiosis and Mendel's laws.
8. Meiosis, clutch and crossing-over.
9. Use of formulas for determining the number of gamete varieties, the number of cleavage classes by phenotype and genotype, phenotypic radicals to predict the results of crosses (problem solving). Prognosis of cleavage in a series of generations in self- and cross-fertilizing organisms (problem solving).
10. Differential viability of zygotes as a reason for deviation of empirical cleavage relations from theoretically expected ones: genetic analysis of inheritance of platinum coloration and silvery white-faced in foxes, yellow coloration of mice, type of carp scales (problem solving).
11. Analysis of mono- and dihybrid crosses in neurospores.
12. Study of the genetic system of the trait "eye coloration" in Drosophila based on the results of polyallelic crosses of 4 laboratory lines of Drosophila (white, w-apricot, brown, scarlet). Description of splitting in the first and second generations of hybrids in the system of reciprocal crosses, hybridological analysis, writing a report on the work.
13. Genetic analysis of inheritance of yellow body coloration, bright red eye coloration and cut wings in Drosophila: description of cleavage in F1 and Fb, gene mapping.

14. Estimation of the distances between genes based on the results of cleavage analysis in F2 (problem solving). Determining the distance between interacting genes (problem solving).

15. Linear combination of features is a fundamental concept of multivariate analysis.

16. The principle of taking into account the initial variability in the transition from the space of features to the space of their linear combinations.

17. Problems solved using the principal component method.

18. Analysis of object distribution and feature loads. Examples of the use of the method in genetics and breeding.

19. Study the differences between groups of objects. Minimization of intragroup variability.

20. Selection of an informative set of features based on the values of standardized coefficients.

Interview Questions

A means of control organized as a special conversation between the teacher and the student on topics related to the discipline being studied, and designed to find out the amount of knowledge of the student on a certain section, topic, problem, etc.

Topic: "Formation of ideas about the gene. Reparation. Recombination"

Interview Questions:

1. The main stages in the development of the gene concept.
2. Evidence of mutational and recombination gene divisibility.
3. The concept of "one gene-one polypeptide chain".
4. Types of reparation processes.
5. Excisional DNA repair.
6. Types of recombinations, their meaning.
7. Holliday's molecular model of total recombination

Population Genetics Theme

Interview Questions:

1. Genetic structure of the population.
2. The Hardy-Weinberg Law: Its Meaning and Application.
3. Factors of population dynamics.
4. Genetic heterogeneity of populations and methods of its study.

Recommended Abstract Topics:

1. The science of genetics and its relation to other sciences.

2. The importance of the works of G. Mendel, T. Morgan, N.K. Koltsov for the development of human genetics.
3. Molecular Basis of Heredity.
4. Variability and its types
5. Nuclear and cytoplasmic heredity
6. Sex Genetics
7. Medical genetics, the history of its development, the main tasks, development prospects.
8. Methods of studying human genetics.
9. Genetics of hereditary diseases
10. Gene diseases (autosomal inheritance, sex-linked inheritance).
11. Chromosomal diseases: Down, Klinefelter and Shereshevsky-Turner syndromes.
12. Genetics of oligophrenia.
13. Genetics of Schizophrenia and Affective Psychoses.
14. Diseases with a hereditary predisposition.
15. Hereditary pathology of the hearing organ.
16. Hereditary pathology of the organ of vision.
17. The role of heredity in speech retardation and speech pathology.
18. Therapy of hereditary diseases
19. Pharmacogenetics
20. Hereditary enzymopathies.
21. Hereditary nervous and neuromuscular diseases.
22. Genetics of malignant neoplasms.
23. Radiation genetics.
24. Genetics of Mental Illness
25. Prenatal diagnosis, methods and significance.
26. Methods and Importance of Early Diagnosis of Hereditary Diseases.
27. Genetic Engineering, Its Current Problems and Prospects.
28. Prevention of hereditary pathology.
29. Organization and Importance of Medical Genetic Counseling.
30. Social and Ethical Problems of Medical Genetics.

Examples of test tasks

1. Ethical Aspects of Human DNA Testing:

(a) Research on human DNA recombination should be known to the expert commission on genetic engineering in the country concerned;

b) it is forbidden to clone human DNA, to grow chimeras and hybrids from human and animal genetic material;

c) gene transplantation for therapeutic purposes is permissible only from somatic cells;

d) manipulation of germ cells is allowed only in cases where it is impossible to use somatic cells in the experiment;

e) the genetic data of any person is stored and not disclosed.

2. Conditions for the manifestation of G. Mendel's laws:

(a) Equally probable formation of gametes of all varieties by hybrids and equally probable combinations thereof at fertilization;

b) equal viability of zygotes of all genotypes;

c) the full manifestation of the trait regardless of the conditions of the organism's development;

d) finding the genes to be taken into account in non-homologous chromosomes during di- and polyflexible crosses.

3. In what cases is an analysing cross performed?

a) to determine the genotype of an individual with a dominant trait;

b) to determine the genotype of an individual with a recessive trait;

c) to determine the types of gametes in an individual with a recessive trait.

43. Diseases Fully Linked to Sex:

(a) Haemophilia C;

b) hemophilia A, B;

c) color blindness, Duchenne muscular dystrophy;

d) hemorrhagic diathesis.

4. What is full traction?

(a) The genes responsible for the traits are located in the heterologous region of the X chromosome;

b) the genes responsible for the traits are located in a heterologous region of the Y chromosome;

c) The genes responsible for the traits are located in the homologous regions of the X and Y chromosomes.

5. What are holandric signs?

a) the gene responsible for the trait is located in a heterologous region of the Y chromosome;

b) the gene responsible for the trait is located in a heterologous region of the X chromosome;

c) the genes responsible for the trait are localized in homologous regions of the X and Y chromosomes.

6. Holandric characteristics of man:

(a) Syndactyly;

b) hypertrichosis of the earlobe;

c) general color blindness;

d) increased keratinization of the skin.

7. Qualitative characteristics of gene manifestation:

(a) Expressiveness;

b) penetrance;

c) the field of action of the gene.

8. The Role of Ontogenetic Variation:

(a) Is adaptive;

b) plays a role in the manifestation of hereditary diseases of a person;

c) is indefinite.

9. Basic mechanisms of ontogenetic variation:

(a) Different gene activity at different ages;

b) different activity of the endocrine glands in different age periods;

c) different correlation of growth and differentiation processes in different age periods.

10. Examples of hereditary diseases and malformations occurring in the embryonic period:

a) polydactyly, syndactyly;

b) cerebellar ataxia;

c) diabetes mellitus;

d) cranioclavicular dysostosis.

11. Examples of hereditary diseases that manifest themselves in childhood:

(a) Syndactyly;

b) Friedreich's familial ataxia;

c) gout;

d) Alkaptonuria.

12. Examples of hereditary diseases that manifest themselves in adulthood:

a) cerebellar ataxia;

b) alkaptonuria;

c) gout;

d) hapaktosemia.

13. Definition of Inhybridization:

(a) Marriage between relatives;

(b) Marriage between siblings;

c) marriage between unrelated persons.

14. Consequences of Inbreeding:

(a) Dividing the population into separate pure lines;

b) conversion of pathological recessive genes into a homozygous state;

c) manifestation of hereditary disease, decrease in vitality, death of individuals.

15. Definition of Outbreeding:

(a) Marriage between relatives;

(b) Marriage between siblings;

c) marriage between people who have not had common relatives for 4-6 generations.

16. Types of mutations by alteration of hereditary material:

a) gene, chromosomal, interchromosomal, genomic;

b) generative;

c) cytoplasmic;

d) spontaneous.

17. Characteristics of generative mutations:

(a) Occur in somatic cells;

b) occur in germ cells;

c) are transmitted from generation to generation through sexual reproduction;

d) the consequences of the mutation are more severe if they occur in the early stages of gametogenesis.

18. Types of local changes underlying gene mutations:

a) substitution, rearrangement of a pair of nucleotides;

b) insertion, loss of a pair of nucleotides;

c) hyphens, deletions.

19. Types of genomic mutations:

(a) Translocations;

b) hyphens;

c) polyploidy;

d) heteroploidy.

20. Cytoplasmic hereditary diseases of humans:

a) Spina bifida, Albright's osteite;

b) anencephaly;

c) Duchenne muscular dystrophy;

d) some types of myolatia.

21. Examples of neutral mutations in humans:

(a) Polydactyly;

b) hypertrichosis of the earlobe;

c) congenital ichthyosis;

d) hemophilia;

e) anophthalmia.

22. Examples of lethal mutations in humans:

(a) Brachydactyly in a homozygous state;

b) YO syndrome;

c) Edwards-Smith syndrome;

d) Bartholomy-Patau syndrome;

e) Konovalov-Wilson disease.

23. Types of mutations caused by ionizing radiation:

(a) Gene mutations;

b) genomic mutations;

c) chromosomal and interchromosomal mutations;

d) formation of thymine dimers.

24. Types of mutations caused by helminth metabolites:

(a) Translocations;

b) gene mutations;

c) chromosomal breaks;

d) heteroploidy.

25. Difficulties associated with the study of human genetics:

(a) The impossibility of carrying out voluntary and analysing crosses between humans;

b) slow change of generations and small number of offspring;

c) late puberty, long-term bearing of a child in the mother's womb;

d) different social conditions of people's lives.

26. Possibilities of the genealogical method of anthropogenetics:

(a) Determination of the nature of the disease;

b) determination of the type and variant of inheritance;

c) detection of heterozygous carriage of the pathological gene;

d) in a number of cases, determining the probability of giving birth to a child with a hereditary pathology.

27. The data of the genealogical examination of the proband make it possible to establish:

(a) The nature of the disease;

b) type and variant of inheritance;

c) heterozygous carriage of a pathological gene;

d) in case of monogenic inheritance, the probability of giving birth to a child with a hereditary pathology.

28. Characteristics of the autosomal dominant type of inheritance:

(a) The attribute is traceable only horizontally;

b) the attribute can be traced horizontally and vertically;

c) men and women are equally affected;

d) in order for the child to be sick, one of the parents must be ill;

e) The gene is manifested in homo- and heterozygous states.

29. Characteristics of the dominant X-linked type of inheritance:

(a) The attribute can be traced horizontally and vertically;

b) women are more likely to get sick;

c) men are affected, and women are heterozygous carriers of the pathological gene;

d) the gene is manifested in a hemizygous state in women;

e) In order for a child to be sick, one of the parents must be sick.

30. Characteristics of recessive X-linked inheritance:

(a) The attribute is horizontal;

b) men are ill, women are carriers of the pathological gene;

c) the pathological gene is inherited from the mother to the son, from the father to the daughter;

d) men and women are equally affected;

e) If the father is healthy and the mother is a carrier of the pathological gene, half of the sons will be sick, half of the daughters will be carriers of the pathological gene.

31. Possibilities of the twin method of anthropogenetics:

(a) Clarification of the list of hereditary diseases and diseases with hereditary predisposition;

b) determination of the role of hereditary factors and environment in the manifestation of the disease;

c) timely prevention of the illness of one of the twins in case of the illness of the other.

32. Possibilities of the cytogenetic method of anthropogenetics:

a) makes it possible to identify hereditary diseases associated with changes in the number and structure of chromosomes and translocation;

b) allows you to determine the type and type of inheritance;

c) allows to identify hereditary metabolic diseases.

33. Possibilities of the express method for determining sex chromatin:

(a) Detection of hereditary diseases associated with changes in the structure of sex chromosomes;

b) detection of hereditary diseases associated with changes in the number of sex chromosomes;

c) sex determination in hermaphroditism and transsexualism;

d) determination of the sex of the fetus in case of suspicion of sex-linked diseases;

e) determination of gender in forensic examination.

34. The number of X-chromatin-positive nuclei of the buccal epithelium is normal:

(a) 50-60 per cent for women and 0 per cent for men;

b) 60-70% for women and 1-2% for men;

c) 20-40% for women, 1-3% for men.

35. How is the intensity of the pattern determined in dermatoglyphic analysis?

(a) Comb counting;

b) the value of the angle atd;

c) counting the number of triradii.

36. Dermatoglyphic indicators in Shereshevsky-Turner syndrome:

(a) Four-finger sulcus;

b) an increase in the frequency of patterns on the hypotenor;

c) an increase in the number of curls and comb counting;

d) radial loops on the 4th and 5th fingers;

e) ATD angle = 60-61°.

37. Optimal timing of chorionopexy in prenatal diagnosis:

(a) 6-7 weeks of pregnancy;

b) 12-13 weeks of pregnancy;

c) 13-14 weeks of pregnancy;

d) 14-16 weeks of pregnancy.

38. Optimal timing of amniocentesis in prenatal diagnosis:

(a) 6-7 weeks of pregnancy;

b) 12-13 weeks of pregnancy;

c) 14-16 weeks of pregnancy;

d) 26-28 weeks of pregnancy.

39. Consequences of Rh conflict in a newborn:

(a) Jaundice;

b) dropsy;

c) anemia;

d) hydrocephalus.

40. Examples of hereditary diseases of amino acid metabolism disorders:

(a) Galactoemia

b) vitamin D-resistant rickets;

c) phenylketonuria;

d) alkaptonuria;

e) albinism.

41. Causes of phenylketonuria;

(a) Lack of homogentisic acid oxidase enzyme;

b) lack of the enzyme phenylalanine dehydroxylase;

c) accumulation of phenylpyruvic acid in the blood.
42. Diagnosis of phenylketonuria in a newborn:
(a) An indicator paper moistened with 3% FeCI3;
b) addition of 5% hydrochloric acid to the urine;
c) determination of meteonine content.
43. Examples of hereditary diseases associated with blood clotting disorders:
(a) Thalassemia;
b) von Willebrand disease;
c) hemophilia A and B;
d) sphingolipidosis;
e) hemoglobinopathy S.
44. Main etiological factor of hemophilia A:
(a) Factor IX defect (Christmas factor);
b) factor VIII (antihemophilic globulin) defect;
c) a defect in the integrity factor of the blood vessel walls.
45. The main etiological factor of hemophilia B:
(a) Factor VIII (antihemophilic globulin) defect;
b) factor VII (proconvertin) defect;
c) Factor IX defect (Christmas factor).
46. Etiological factor of von Willebrand disease:
(a) Factor VIII (antihemophilic globulin) defect;
b) factor VII (proconvertin) defect;
c) a defect in the integrity factor of the blood vessel walls.
47. Examples of hereditary hemoglobinopathies:
(a) Sickle cell anaemia;
b) thalassemia;
c) fructosuria;
d) hemoglobinopathy D;
e) Cooley's disease.
48. Diseases of metal metabolism:
(a) Hepatolenticular degeneration (Konovalov-Wilson disease);
b) hemochromatoses;
c) von Willebrand disease;
d) cystinuria.
49. Trisomy 13 syndrome:
(a) Shereshevsky-Turner;
b) Edwards-Smith;
c) Down;
d) Bartholomew-Patau;

e) Kleinfelter.

50. Examples of hereditary human diseases associated with changes in the number of sex chromosomes:

(a) Shereshevsky-Turner syndrome;

b) trisomy X syndrome;

c) Klinefelter syndrome;

d) Extra Y chromosome syndrome in males;

e) YO syndrome.

Assessment Tools for Intermediate Attestation

Questions for the test

1. Methods of genetics, its significance, the main stages of the development of genetics. The Role of Russian Scientists in the Development of Genetics.

2. Methods of genetics: hybridological, cytological, mutational, molecular-genetic, mathematical, etc.

3. Chromosomes: structure and functions. Hetero- and euchromatin regions of chromosomes. Karyotype, its characteristics.

4. Molecular organization of chromosomes. Chromatin packing levels. Nucleosomes.

5. Genetic material, genetic information. The Role of the Nucleus and Chromosomes in the Phenomena of Heredity.

6. The cell cycle: its periods. Mitosis: phases of mitosis, genetic and biological role of mitosis.

7. Meiosis and sexual reproduction. Phases and stages of meiosis, its genetic role. Features of meiosis in plants and animals.

8. Common features and differences of mitosis and meiosis, their genetic role.

9. Homo- and heterozygosity. Conditions required for hybridological analysis. The Significance of G. Mendel's Works.

10. Patterns of inheritance in mono- and dihybrid crossing. Allelic interaction of genes, the law of "purity" of gametes.

11. Patterns of inheritance in di- and polyhybrid crosses. Statistical nature of cleavage.

12. Non-allelic gene interactions: complementarity, epistasis, pleiotropy, polymery.

13. Non-allelic interaction of genes. Expressiveness and penetrance.

14. Extranuclear inheritance. Plastid and mitochondrial inheritance. Cytoplasmic male sterility in plants.

15. Extranuclear inheritance. Inheritance through infection, viruses, extrachromosomal elements. Maternal cytoplasmic effect.

16. Genetics of sex. Sex chromosomes. Types of chromosomal sex determination. Balance Theory of Sex Determination.

17. Inheritance of sex-restricted and sex-dependent traits. Grip on the floor.

18. T.Morgan's chromosomal theory of heredity. Features of inheritance in gene linkage. Crossing-over.

19. Basic Provisions of the Chromosomal Theory of Heredity.

20. Recombination rate and genetic mapping in eukaryotes. The Importance of Analysing Crossing in the Study of Crossing-Over.

21. Types of recombinations, their significance. Holliday's molecular model of total recombination

22. Evidence for the genetic role of nucleic acids. DNA and RNA. The DNA model of J. Watson and F. Crick.

23. Genetic code. Structure and main features of the genetic code.

24. DNA replication. The concept of a replicon. Events in the replication fork. Genetic control of replication.

25. Functions of nucleic acids in the realization of genetic information (replication, transcription, translation).

26. Types of structural DNA damage and reparative processes. Excisional DNA repair.

27. The Concept of Hereditary and Non-Hereditary Variation. Genotype response rate.

28. Modificational variability. Types of modifications, mechanism of their occurrence, significance.

29. Mutational theory. Classification of the main forms of variability of genetic material.

30. Mutational process. Thinking of mutations as rare, random, undirected changes in genetic material.

31. Mutagens and antimutagens. Understanding of direct and reverse mutations, adaptive, neutral, lethal, generative, vegetative, recessive, dominant mutations.

32. Spontaneous and induced mutational process. Mutagens: classification, mechanism of action. Antimutagens. Mechanism of mutagenic action of base analogues.

33. Gene mutations: classification, mechanisms of their occurrence, genetic role.

34. Chromosomal rearrangements: types, mechanism of occurrence, significance. The role of chromosomal mutations in evolution.

35. Genomic changes: polyploidy, aneuploidy. The role of polyploidy in evolution and selection.

36. Genetic and Cell Engineering: Their Importance for Solving the Problems of Biotechnology, Agriculture, and Medicine. Production of transgenic organisms.

37. Biochemical Genetics: Genes and Enzymes. The concept of "one gene-one polypeptide chain".

38. Main stages in the development of the gene concept. Evidence of mutational and recombination gene divisibility.

39. Molecular structure of the gene in prokaryotes and eukaryotes. Intron-exon organization of genes in eukaryotes. Splicing.

40. Control of gene expression. Jacob and Monod's theory. Genetic analysis of the lactose operon.

41. Regulation of gene expression. The concept of an operon. Regulatory genes.

42. Genetic structure of the population. Hardy-Weinberg's Law: Its Application and Significance.

43. Factors influencing the dynamics of the genetic composition of the population. Basic Forms of Selection in Populations.

44. Organization of the genetic apparatus in bacteria. Methods used in genetic analysis in bacteria and bacteriophages.

45. Genetic analysis in prokaryotes and eukaryotes. Genetic recombination in bacteria: conjugation, transformation, transduction.

46. Transposons, plasmids, episomes. The Role of Mobile Genetic Elements in Genetic Processes.

47. Fundamentals of Genetic Engineering. Methods of gene synthesis and isolation. The concept of vectors. Methods of gene cloning.

48. Human genetics. Methods of studying human genetics. Genetic diseases. The Human Genome Project

49. Hereditary human diseases caused by gene and chromosomal mutations.

50. Causes of hereditary and congenital diseases in humans. Genetic diseases.